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Setting up a weather research and forecasting model for rainfall prediction in Upper Mahaweli basin

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Upper Mahaweli basin, which is the Mahaweli River sub-basin above the Polgolla reservoir, has a special importance in the water management of Sri Lanka.Reliable weather prediction in the basin is especially important for the operation of a number of reservoirs in the basin.

Simulating the natural atmosphere by using computer models is the main tool that is used for weather prediction. In this study, Weather Research and Forecasting (WRF) model is used to downscale global scale weather prediction data to obtain rainfall prediction over the Upper Mahaweli basin. WRF model is a regional weather forecasting model and it is a mesoscale numerical weather prediction system designed to serve both operational forecasting and atmospheric research needs.

The WRF model was calibrated using National Centers for Environmental Prediction (NCEP) reanalysis data for forecasting extreme rainfall in the Upper Mahaweli basin by selecting appropriate physics options of the model including microphysics schemes, cumulus parameterization schemes, land surface schemes, planetary boundary layer schemes, surface layer schemes and radiation physics schemes. WRF predictions were compared with the observed point rainfall data of selected gauging stations within the catchment. Observed point rainfall data were distributed to the same grid of WRF predictions by GIS based Inverse Distance Weighting (IDW) technique. After the comparison of WRF prediction with observed rainfall, a most appropriate physics combination was selected for rainfall prediction. Then the calibrated model was satisfactorily validated for few other rainfall events in the reservoir catchment.

NSSL 2-mom microphysics scheme, Kain-Fritsch cumulus parameterization scheme, CAM shortwave radiation scheme, RRTM long wave radiation scheme, YSU planetary boundary layer scheme, Noah land surface scheme and Revised MM5 surface layer scheme with other default physics options are the most suitable physics combinations for the Upper Mahaweli basin. This combination gave the least Root Mean Square Error (RMSE) of 11 mm at the calibration stage. In the validation process the model was run with optimized physics combination and RMSEs of 18 mm and 20 mm were obtained for two other extreme rainfall events. Calibrated WRF model is a useful tool for rainfall prediction in Upper Mahaweli basin.